The College of New Jersey

Background

The College of New Jersey (TCNJ) is located in Ewing, NJ, and is part of New Jersey's state system of higher education. The campus occupies 340 acres and has a central steam, chilled water, and cogeneration plant to service 3.2 million square feet of building space, including housing facilities for students. There are currently 6,700 students enrolled at the college.

Project Description

In late 1999, the four-year-old 3.2 MW Solar Centaur T-4700 water-injected gas turbine was scheduled for an overhaul. However, recognizing the need for a larger turbine to accommodate increased campus energy demand, TCNJ decided to replace, rather than refurbish, the existing turbine. The new turbine increased the plant's power output by 2 MW, improved efficiency to 77%, and improved the environmental performance of the plant. The new Solar Taurus 60 gas turbine was installed in December 1999 with minimal modifications to the existing heat recovery steam generator (HRSG)/duct burner and other plant equipment. The gas turbine and duct burner use natural gas as the primary fuel. Distillate fuel oil with a sulfur content of 0.1% (by weight) is used when natural gas is not available.

TCNJ Cogeneration Plant Operating Data for 2000*	
Project Design Capacity (MW_e)	5.2
Power to Heat Ratio	0.5
Total Net Efficiency (HHV)	77%
% Fuel Savings[1]	13% (900 metric tons of carbon)
Effective Electric Efficiency[2] (HHV)	71%
% NO_x Decrease[3]	72% (55 tons)

**Data based on 8,342.75 annual hours of operation*

Success Strategy

The air permit obtained by TCNJ for the larger turbine required the plant to meet more stringent emission limits of 25 part per million (ppmdv) for NO_x and 50 ppmdv for carbon monoxide. However, at the time the project was being evaluated in July 1999, Solar Turbines did not manufacture a Centaur gas turbine capable of achieving the required emissions limit. Therefore, the College decided to install a 5.2 MW Solar Taurus 60 gas turbine with SoLoNo$_x$ technology that met the necessary emissions requirements.

[1] Savings based on 50% efficient electric and 80% efficient thermal generation with natural gas as the primary fuel.
[2] Effective Electric Efficiency = (CHP power output)/(Total energy input to CHP system – total heat recovered/0.8). Assumes thermal output provided at 80% efficiency.
[3] Compared to electric emissions of 3.6 lb NO_x/MWh (1998 national average) and boiler emissions of 0.1 lb NO_x/MMBtu.

Benefits

By switching from a 3.2 MW output to a 5.2 MW output, the project increased the amount of on-site generation from 68% to 90% of total campus electricity needs. In addition, by installing a new gas turbine instead of overhauling the existing Centaur turbine, the amount of available waste heat increased by 30%. This in turn reduced the duct burner firing duty by 36%. Even though the power output of the plant rose by 56%, by replacing a 42-ppm turbine with a 25-ppm turbine there was a reduction in potential NO_x emissions of 2.6 tons/yr. The replacement of the water injection system with a dry low NO_x combustor yielded the extra benefit of decreasing water consumption. The annual NO_x reduction from this facility is equivalent to the annual emissions from 2,800 vehicles.

The project provides significant financial benefits to the college. In spite of higher gas prices, total cost savings in the year 2000 were $3.2 million. TCNJ expected to save more than $3.6 million in 2001.

The project also offers significant climate benefits. The effective electric efficiency of the facility is 71%. This is 17% better than the best electric-only fossil-fired generation. Compared to separate heat and power, the project annually conserves 66 million standard cubic feet of natural gas and emits 3,800 fewer tons of CO_2. This is equivalent to planting 1,000 acres of trees or offsetting the annual greenhouse gas emissions from 340 households.

In March 2001, the United States Environmental Protection Agency and Department of Energy presented an ENERGY STAR® CHP Award to The College of New Jersey for "demonstrating leadership in its campus energy supply." For more information on ENERGY STAR® CHP awards, please click here.